UNIVERSITY OF SASKATCHEWAN

College of Engineering

G.E. 120.3

Introduction to Engineering II

FINAL EXAMINATION #1

March 4th, 2002

7:00 PM - 9:00 PM

STUDENT NAME: _____

STUDENT NUMBER: _____

LECTURE SECTION:
- L02 Tu-Th 11:30 – 1:00 Prof. H.C. Wood
- L04 Tu-Th 1:00 – 2:30 Prof. T.G. Crowe
- L06 Tu-Th 2:30 – 4:00 Prof. T.C. Muench

Question 1	/ 13
Question 2	/ 10
Question 3	/ 10
Question 4	/ 12
Question 5	/ 10
Question 6	/ 10
TOTAL	/ 65

GENERAL INSTRUCTIONS FOR THE QUESTIONS

1) **NO** textbooks, **NO** notes, **NO** assignments, and **NO** laboratory logbooks/reports.
2) **NO calculators allowed**.
3) Neatness counts. Please ensure your paper is readable.
4) Some questions contain special instructions. Please ensure that you read these carefully.
5) Not all questions are of the same difficulty and value. Consider this when allocating time for the solution.
6) *IF A QUESTION PROVES TO BE TOO HARD FOR YOU TO SOLVE, GO ON TO ANOTHER QUESTION! RETURN TO THE TROUBLESOME QUESTION WHEN TIME PERMITS.*

PLEASE NOTE

ALL parts of the examination paper MUST be handed in before leaving.

Please check that your examination paper contains 7 pages TOTAL.

QUESTION #1

MARKS: 13 (5 + 8)

a) Engineers describe the design process in several ways. One of the descriptions includes the four BIG questions: generally what, generally how, specifically what, and specifically how. Another of the descriptions divides the design process into ten steps. Clearly, these two different descriptions are for the same process, so there should be a good correspondence between the two. In the following lists, the BIG 4 are in a column on the left, and the ten steps are in a column on the right.

The task is to match the items on the right with the corresponding categories on the left by drawing straight lines from each of the ten items on the right to the correct category on the left. There can be one and only one line from each item on the right.

BIG 4	**10 Steps**
	Search
Generally What	Analyze
	Specify
Specifically What	Define problem
	Establish criteria
Generally How	Make decision
	Communicate
Specifically How	Determine alternative solutions
	Identify the need
	Define constraints

b) b) A client has come to your professional engineering firm to have you design bookshelves for a new office. Within the context of the BIG 4 above, define at least two specific activities you would perform within each category to complete the design. Assume that you will have the bookshelves manufactured in a city 1000 km away.

QUESTION #2

MARKS: 10 (5 + 5)

1) The presentation by Professor Bugg, describing the discipline of Mechanical Engineering included a picture of the U of S campus from a distance. The picture was taken during the winter and the plume of steam from the stacks at the heating plant on campus were evident. Using this picture as an example, Professor Bugg described how mechanical engineers are involved in:
   a) heating systems and analyses of heat loss
   b) pollution concerns
   c) analysing the dispersion of components into the atmosphere
   d) none of the above

2) Based on the presentation by Professor Reeves, the program in Geological Engineering
   a) is currently administratively grouped with Geological Sciences in the College of Arts and Science at the U of S.
   b) is distinctly unique, i.e. courses in the undergraduate program are entirely different from any other undergraduate program of studies.
   c) is accredited and graduates from the program are able to work effectively anywhere in the world.
   d) none of the above.

3) The discipline of Electrical Engineering involves
   a) the safe and efficient production of electricity
   b) analog and digital communication
   c) automation and system integration through electronics
   d) all of the above

4) In his presentation, Professor Fonstad indicated that the undergraduate program in Agricultural and Biresource Engineering is "flexible" meaning that
   a) courses in the program have few pre-requisites and can be taken in any order.
   b) courses are often taught by different professors and students are able to select their "favorite teachers".
   c) students are able to customize their programs of study by taking courses that closely match their interests.
   d) students can participate in the engineering internship program and still complete their degrees in 4 years.

5) A graduate from the Mechanical Engineering program would be eligible for employment as
   a) a designer of agricultural seeding implements.
   b) a member of a team that designs food-processing plants
   c) a designer of medical devices
   d) all of the above

True or False (Correct minus incorrect)

1) The Department of Agricultural and Bioresource Engineering is actually a member department in the College of Agriculture, yet it offers an accredited undergraduate program in the College of Engineering. ***Circle: True or False***

2) All of the undergraduate programs that were presented to this point in the course (Mechanical, Agricultural and Bioresource, Geological and Electrical) are accredited programs by the Canadian Engineering Accreditation Board. ***Circle: True or False***

3) Geological Engineering largely involves searching for and documenting the plight of dinosaurs and other prehistoric creatures. ***Circle: True or False***

4) The discipline of Agricultural and Bioresource Engineering encompasses issues related to environmental sustainability, and also overlaps with many of the other disciplines, including Mechanical, Civil, Electrical and Chemical Engineering. ***Circle: True or False***

5) Nortel is the only large company that hires graduates from the Electrical Engineering program at the U of S. ***Circle: True or False***

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QUESTION #3

MARKS: 10 (2 + 4 + 2 + 2)

1. A colleague has given you the following equations to solve. **Set up** the 3 matrices in the form [A][x]=[B], such that they could be solved using the Adjoint Method **DO NOT SOLVE** and show the elements of each.

$5x_1 + 3x_2 + 9x_3 = 11$
$2x_1 + 7x_3 + 5x_2 = 17$
$19x_1 + 18x_2 + 2x_3 = 14$
$18x_3 + 10x_1 + 6x_2 = 22$

2. Given the following matrices,

$$[A] = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \quad [B] = \begin{bmatrix} 2 & 12 \\ -4 & -3 \end{bmatrix}$$

determine [A][B] – [B][A]

3. Given a matrix A,

$$[A] = \begin{bmatrix} 5 & 3 & 9 \\ 2 & 7 & 5 \\ 1 & 6 & 4 \end{bmatrix}$$

Determine $\frac{[A]Adj[A]}{|A|}$

4. Given the following 4 equations, write the Augmented Matrix if it is a Homogeneous Set. **DO NOT SOLVE**.

$2 X_1 + 3 X_2 + 11 X_3 + 7 X_4 = 19$
$9 X_1 + 5 X_2 + 10 X_3 + 13 X_4 = 4$
$17 X_1 + 1 X_2 + 12 X_3 + 6 X_4 = 11$
$4 X_1 + 8 X_2 + 14 X_3 + 16 X_4 = 15$

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QUESTION #4

MARKS: 12 (2 x 6)

Matching: Draw a line from the Question on the left → To the Answer on right

a) Given A = $\begin{bmatrix} -1 & 4 \\ -3 & 3 \end{bmatrix}$ Determine Inverse of A

b) Given A = $\begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix}$ Find determinant of A

c) [A] = $\begin{bmatrix} -8 & 12 & -3 & 13 \\ 2 & -20 & 5 & 11 \\ 21 & 19 & -17 & 25 \\ 14 & -11 & 21 & -3 \end{bmatrix}$ Find Trace of A

d) Given the following equations

$3X_1 + 2X_2 + 9X_3 = 7$
$4X_1 + 9X_2 + 11X_3 = 21$
$5X_1 + 4X_2 + 7X_3 = 14$

If you were solving these equations using Cramer's Rule, what would DX_1 be?

e) What is the rank of the Augmented matrix from question d), above?

f) What is the order of the Augmented matrix from question d), above?

1) $\begin{bmatrix} 7/8 & 9/8 \\ 3/8 & 5/8 \end{bmatrix}$

2) $\begin{vmatrix} 7 & 2 & 9 \\ 21 & 9 & 11 \\ 14 & 4 & 7 \end{vmatrix}$

3) 0

4) $\begin{bmatrix} 7/8 & -9/8 \\ -3/8 & 5/8 \end{bmatrix}$

5) $\begin{vmatrix} 3 & 2 & 9 \\ 4 & 9 & 11 \\ 5 & 4 & 7 \end{vmatrix}$

6) 3 x 4

7) 3

8) -48

9) None of the above

QUESTION #5

MARKS: 10 (10)

An automobile manufacturer buys tires from 3 different suppliers, Roadworthy, Roadfast and Roadspeed. During one week, enough tires were purchased to equip 2000 cars, including one spare for each car, and making sure that each car had all of its tires of the same brand.

The accountant recorded that the number of Roadworthy tires was 2000 more than the total of all other tires. The accountant also paid a total of $444,000 for tires that week, with Roadworthy tires costing $50 each, Roadfast tires costing $40 each, and Roadspeed tires $30 each.

How many cars were produced that week with each brand of tires?

Solve using ANY method

QUESTION #6

MARKS: 10 (10)

Use Gauss Elimination to solve the following set of Simula\taneous equations.

$x + y + 2z = 8$

$-x - 2y + 3z = 1$

$3x - 7y + 4z = 10$

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